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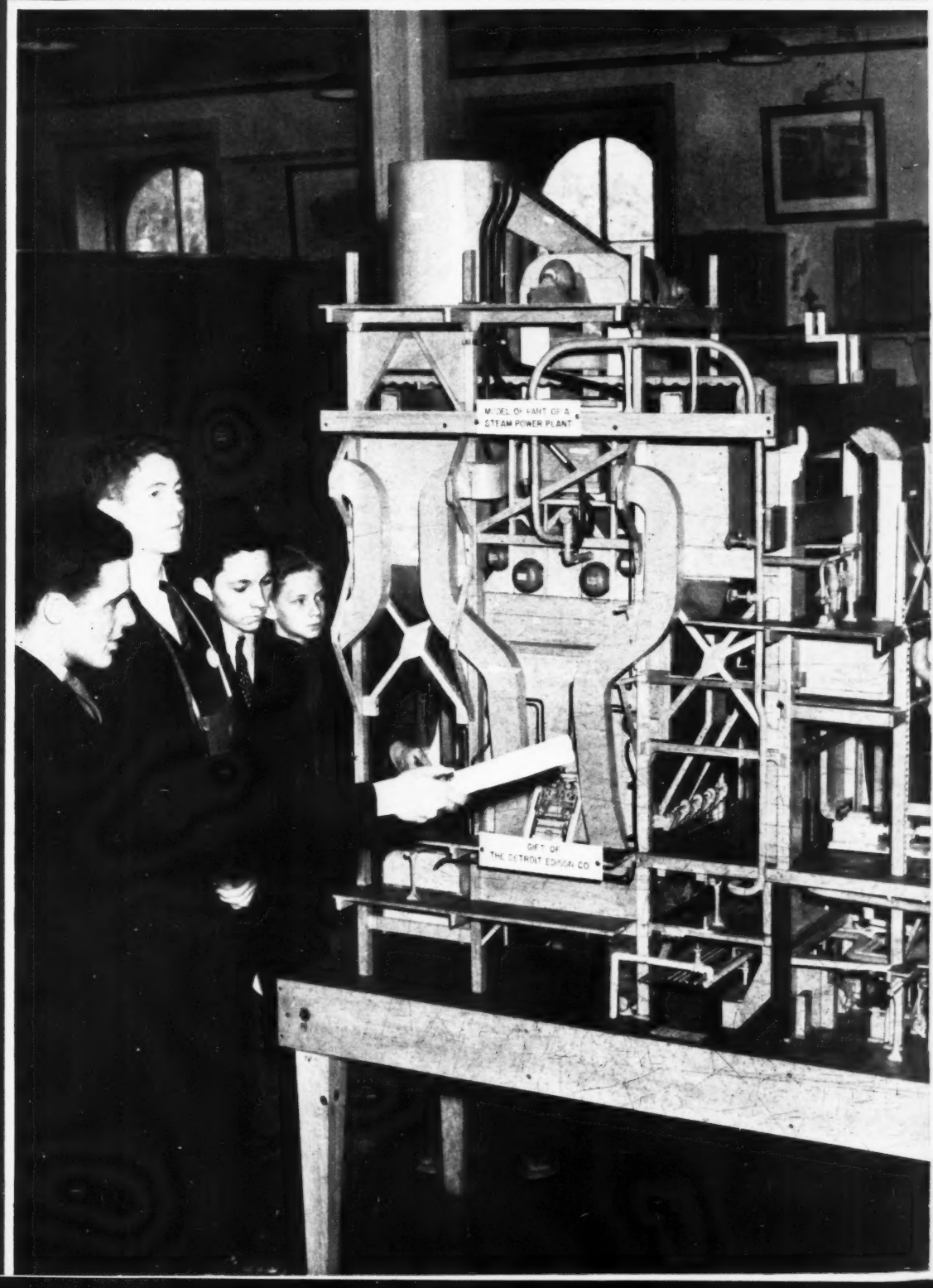

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AUTHORS

Arthur W. Harrington, C.E., was graduated from Cornell University in 1909. His first four years away from school were spent with a small contracting company in his home town, Watertown, N. Y. In 1914 he became connected with the U. S. Geological Survey, was sent to Idaho on stream gaging work for the Water Resources Branch.

1918-1920 saw Mr. Harrington a First Lieutenant in the Sanitary Corps, U. S. Army. Here he supervised work on sanitation for several southern camps, designing an extensive drainage system for Ellington Field, Houston, Tex.

At the end of his service with the U. S. Army, Mr. Harrington again became associated with the Geological Survey, and has been with it ever since, becoming District Engineer in charge of water resources investigation in N. Y. State in 1922. His long experience with the Survey indeed makes him well qualified to write an article on the subject.

Mr. Harrington has served on many committees relative to hydraulic work, has been president of both the Federal Business Ass'n. of Albany, and the Albany section of the Nat'l. Federation of Federal Employees. At present Mr. Harrington is a director in the A.S.C.E.

Elton Wright ("Shorty") Jones was born in New Haven, Connecticut, where he later attended public school. After four years in business he prepared himself to enter the electrical engineering course at the University of Maine. From Maine he received the degrees of B.S. and M.S. (in E.E.) After teaching electrical engineering at his Alma Mater following graduation, he came to Cornell as instructor in his chosen field. Although a large portion of his teaching has been in the theoretical phase of electricity, he has been extremely interested in the development of increased efficiency in laboratory practice. At the present time, in addition to his other duties, he is directing the personnel work of the School of Electrical Engineering.

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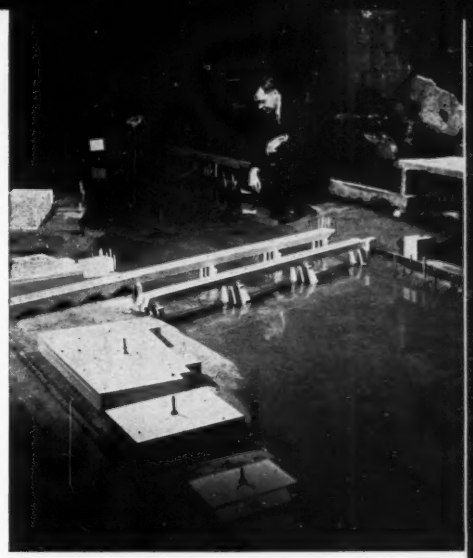

Above

Dean Hollister Inspecting a Flood Control Model.

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COVER

A Cornell Day guide explains to sub-freshmen the various parts of a model steam generating plant.

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FRONTIS

Testing Machines in Lincoln Hall.

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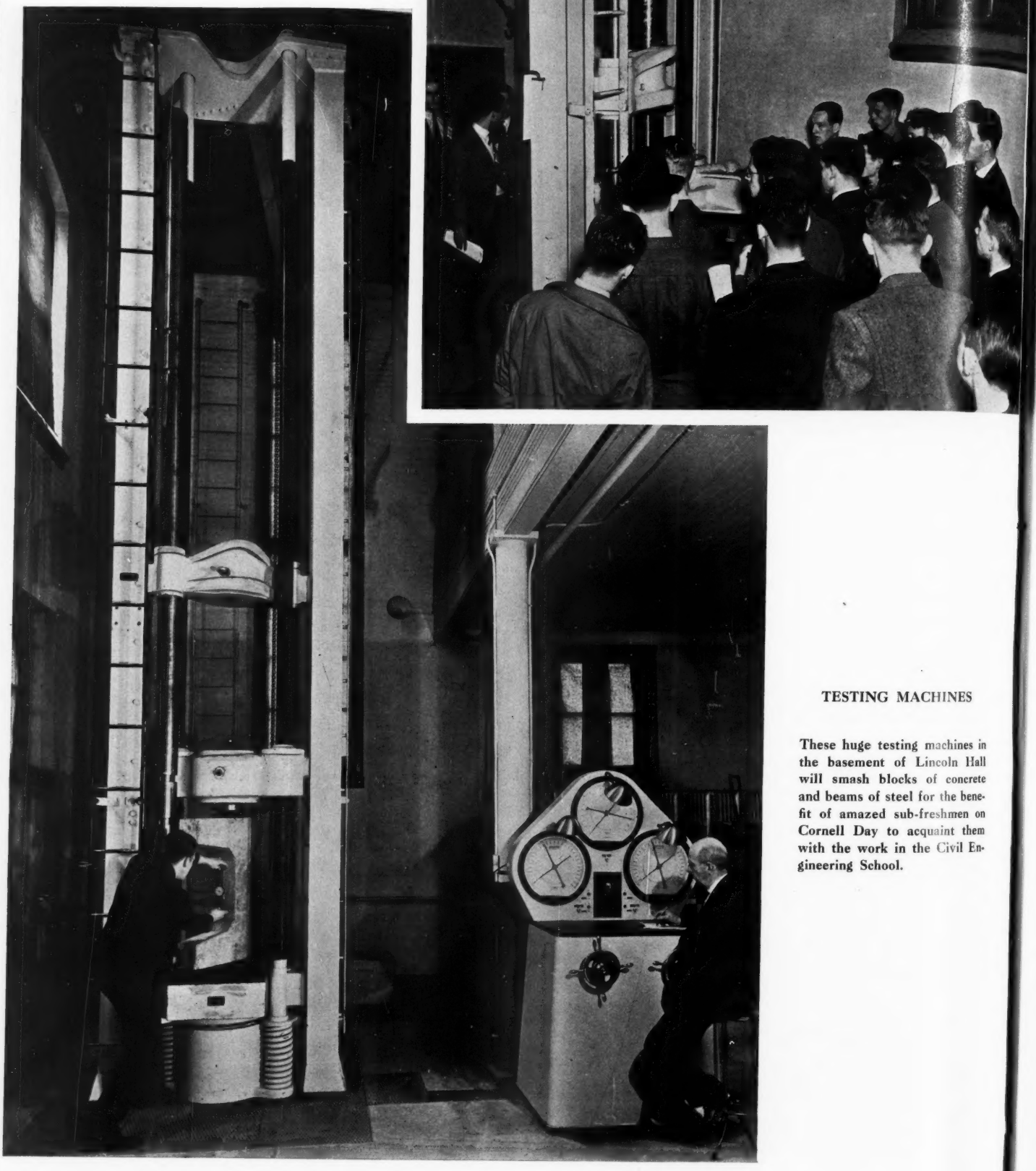


TESTING MACHINES

These huge testing machines in the basement of Lincoln Hall will smash blocks of concrete and beams of steel for the benefit of amazed sub-freshmen on Cornell Day to acquaint them with the work in the Civil Engineering School.

THE INVENTOR'S CONTRIBUTION TO ENGINEERING PROGRESS*

By **DEAN S. C. HOLLISTER**

IMAGINE, if you can, a small classroom in Copenhagen, in the year 1819, equipped for the demonstration of electrical and electro-chemical phenomena then known. There would be a lodestone; a compass; some rods of glass or sealing wax and pieces of cloth to produce static charges to be stored in some Leyden jars; and one of those recent, new-fangled things, a Galvani cell. Prof. Oersted is lecturing to his class, demonstrating the curious effects he can produce. He connects a wire to the cell. By some coincidence the compass is nearby. As he closes the circuit to his great astonishment, the needle turns suddenly to a position at right angles to the wire! He tries it again, and again it performs the same queer antics. More strange still, it turns one way when held below the wire and the opposite way when held above it. He has discovered the relation between current flow and magnetic field.

In a strict sense Oersted's discovery was of a principle and not an invention. A few discoveries are hit upon in the accidental way in which his was hit upon. Most inventions, however, are the result of long, grinding perseverance. An invention is an original contrivance or scheme, a singular arrangement of parts, or a novel sequence of operations. In general, analytical methods are not of much help. Painstaking trial and error, coupled with inspiration, and sustained by determined perseverance, seem to be the inescapable route to success.

News of Oersted's discovery traveled to other centers and eventually to France, where a scientist named Ampère heard of this strange behavior of the magnetic needle. Inside a single week, Ampère completed a paper laying down the whole basis of electrodynamics.

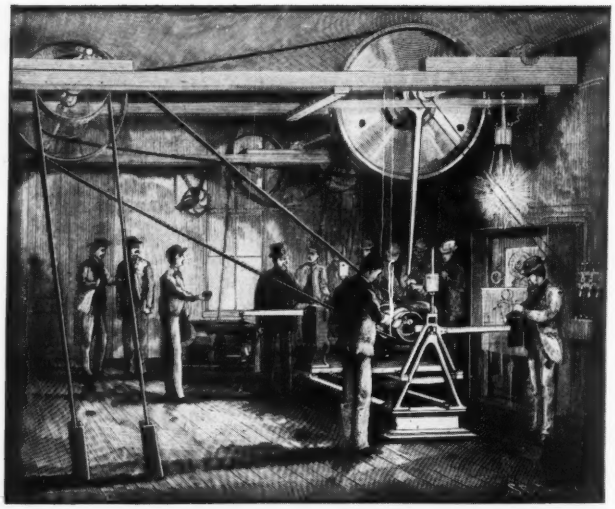
It is hard to measure the importance of this discovery. Under the hand of Joseph Henry, of Michael Faraday, of Morse, of Bell, and a host of others following, all our electrical power machines and most of our electrical appliances, have been built upon this principle. The United States Patent Office records the progress of this development.

It is a curious fact that in nearly all cases invention precedes scientific knowledge. The ancients sailed their ships long before Archimedes stated the law of floating bodies and before anyone enunciated the aerodynamical principles of sails. Canals were built, water wheels invented, and pipes were utilized long before the hydraulic principles of any of these devices were clearly understood.

A good example is furnished by the field of aviation. Leonardo and others after him conceived the idea of heavier-than-air flying machines with flapping wings. Fixed surfaces, such as those in kites, were finally successfully tried. After it was definitely established that flying was possible the theory of aerodynamics was at last developed. It is like settling a new country. The pioneers and first settlers are the inventors who are dreaming in advance of their time. Other inventors follow, building little settlements. Finally painstaking research produces the theory that fills in the whole area like a tight, well-ordered civilization.

One of the great handicaps of the human mind is its slavery to established things. A fine example of what I mean is to be found among other things in the invention by Elias Howe of the sewing machine in 1845 (U. S. Pat. No. 4750). Everyone knows that in hand sewing a needle is used which has an eye at the end opposite the point. The point is inserted in the cloth and the stitch is made by flexing the cloth back and forth while the needle is woven in and out. No one had been able to achieve such a stitch by mechanical means. Certainly Howe's best efforts were of no avail. To my mind the stroke of genius came when Howe forsook convention and decided to develop an entirely new stitch. This breaking with convention is very much more of an heroic act than appears

*An address delivered in Washington, D. C., April 10, 1940, at the celebration of the 150th anniversary of the signing, by George Washington, of the bill creating the U. S. patent system.



First Dynamo in Western Hemisphere. Application of Oersted's Theory Exemplified in Prof. Moler's Apparatus, Developed at Cornell University.

on the surface. Without so doing it is probable that Howe would never have achieved success. He decided to use two threads. One of these, by putting the eye at the point of the needle, could be made to form a loop at every needle-thrust. The other thread, working from a shuttle, could be passed through the loop. A secure stitch could thus be formed. In this way he reduced his mechanical operations to motions in two planes at right angles to each other.

What has the inventor done to advance engineering? The engineer uses tools, materials, processes, and power. It will be of interest to review briefly the inventor's accomplishment in each of these categories.

A hundred years ago most machines were the result of individual craftsmanship. The lathe and milling machine had only recently been invented, near the close of the Eighteenth Century. Gradually they came into use, not only as labor-saving devices, but also as the means of mass production of interchangeable parts. Inventive genius has developed the machine tool into a specialized production unit of high efficiency and accuracy. Today a dimension may be maintained in production to within one-ten-thousandth part of an inch. A hundred years ago even the measurement of so small an amount was hardly attainable.

Without the precision machine tools now available, the achievement of engineers in recent years in the aeronautical and automotive fields would scarcely have been possible.

The inventor's contribution to the materials of engineering runs practically the entire gamut. In the first place we have the invention of steel in commercial quantities. Then we have the invention of a long list of alloy steels for special uses. For example, we have stainless steel for use not only in processes that would be affected by corrosion, but also for use in sections thinner than otherwise would be practical. There are steels particularly suited to the high temperatures of steam turbines or chemical processes; to the corroding effects of brine or acid; to the special strength requirements of such structures as the Golden Gate Bridge; to such hardness and toughness as is needed for high speed machine cutting tools.

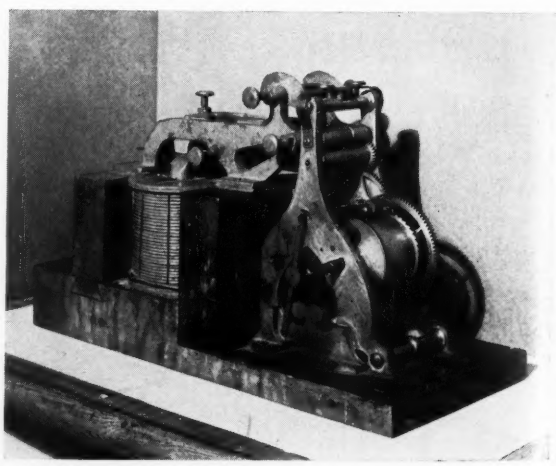
Among the non-ferrous metals we have the alloys of aluminum and of magnesium which combine properties of high strength and lightness of weight. Without these lightweight alloys the high development in modern airplane engines could not have been achieved.

Another recent invention is an alloy of tungsten so hard that it cannot be ground and therefore must be cast into its final form. It is especially useful as a cutting tool for high speed machining.

Among the non-metallic materials there is the development of Portland cement and its further refinement for uses where quick hardening or low chemical heat are desirable characteristics. Such materials have made possible the many hundreds of thousands of miles of concrete pavement and such a gigantic structure as Boulder Dam. They are widely used in the construction of buildings and bridges and of other works for water supply and public sanitation.

A large group of non-metallic materials called plastics has been produced by the chemical industry. These may be either organic or inorganic in origin. These have found a wide variety of uses due to the many special properties possessed by the different products.

One of the most important developments of the inventor in the materials field has been the creation



Original Morse Telegraph Instrument, Now Residing in Sibley Dome at Cornell University.

and perfection of fuels for internal combustion engines. Without them the automobile and the airplane in their present state could not have been created.

In the development of power the inventor has achieved some of his most spectacular success. The steam engine was the first of these. In the early days the boilers were simple drums stiffened by wood staves held on with brass hoops. Later the multitubular boiler was invented and the drums were made heavier so that much higher pressures could be used. The boiler and engine were therefore being improved to mutual advantage.

Soon the steam engine was introduced as the motive power for railroads. Up to this time only horse-drawn vehicles had been used. There soon followed the application of steam to ships. Through the use of the steam engine in manufacture and transportation an industrial and commercial expansion followed which in fact was the rise of the industrial era.

Within the last generation there has been witnessed the entire development of applied electricity. In the beginning it was used for street lighting and for simple prime movers. Later it was extended to the street railway car. Then followed its gradual adoption as a source of power and light in the home. Its convenience and adaptability have led to its general use throughout the nation.

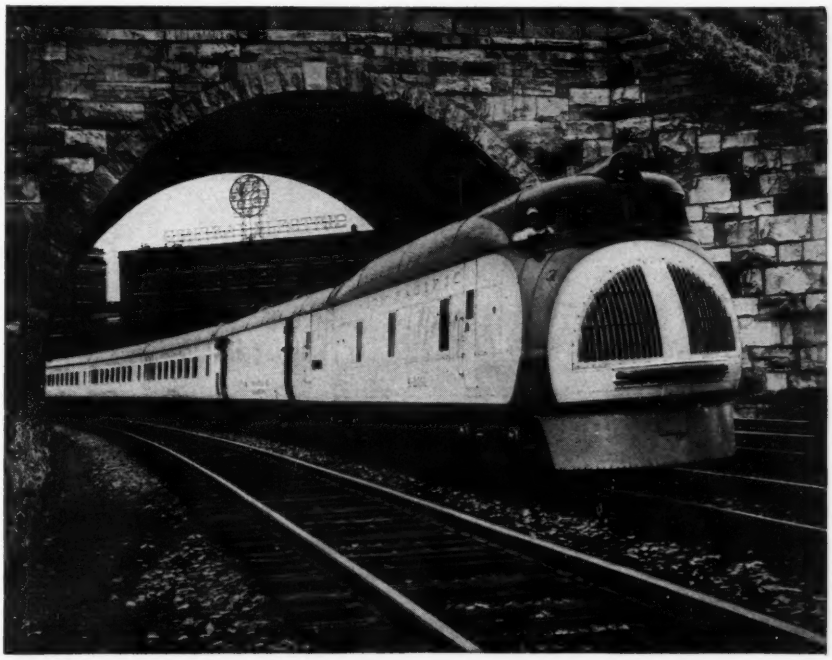
Before its development as a source of power, however, electricity was being generated by batteries for use in long distance communication following the invention of the telegraph instrument. This was the forerunner of the great communication system of the present day. Through inventive genius we now can not only transmit the spoken word, but we may do so across the earth without the use of wires. Even beyond this astonishing achievement we are already able to transmit and reproduce a scene envisioned many miles away.

In recent decades the internal combustion engine has been perfected to a point where now it will deliver one horse power to approximately each pound of its weight. No other prime mover has been invented to equal such efficiency.

A significant fact in all of this vast development is that basic inventions precede the crystallization of fundamental theory. The principles of thermodynamics were not propounded until after the invention of the steam engine. Little of metallurgy and nothing of metallography was known until after steel was available as a cheap commercial material. In each field the basic invention has served to initiate the experimentation that finally resulted in the scientific knowledge that we possess today.

It is clear then what the inventor has done for engineering. He has initiated and accelerated the growth from the artisan to the engineer. He has been a vital factor in the creation of the engineering profession.

And what has engineering done for the inventor? Through the development and application of scientific principles he has not only supplied necessary controls for design, construction, and operation, but he has in addition provided the great background of knowledge for use in further invention. In earlier times the inventor was an individualist. Today he is most likely to work in groups. The time has passed when it is easy for the lawyer or the doctor to come forth with a fundamental invention.



Invention of Durable Light Alloys Made Possible Development of Fleet, Streamlined Trains Such as This.

As I see it, there is an element of danger in this situation. As the inventor is surrounded with so much established thinking, it is increasingly more difficult for him to break with convention and strike out into the unknown. That is ever his task, and however engineering develops in the future, it will be determined in large measure by his accomplishment of that task.

Finally, it is of utmost importance that stimulus to invention be afforded through the protection made available by an adequate patent system. It is sig-

(*Continued on page* 28)

EXPERIMENTAL DIELECTRICS

A Discussion of Recent Research Done in the School of Electrical Engineering

By E. W. JONES, M.S.

A LITTLE over two years ago Professor R. F. Chamberlain suggested that the School of Electrical Engineering equip a laboratory for dielectric research and testing. Plans were then made to provide equipment and facilities for dielectric strength tests, 60-cycle power factor and capacitance measurements, resistivity measurements and studies of the effects of variable frequency and variable temperature on the power factor and dielectric constant of solid and liquid dielectrics.

Dielectric strength tests are made for the purpose of determining the value to which a voltage can be raised before failure or breakdown of the dielectric occurs. Then, the voltage at failure divided by the thickness of the dielectric gives the dielectric strength in Volts per Unit Thickness and is a measure of the insulating properties. Voltage for these tests is provided by a 60-cycle, 50,000-volt transformer.

Power factor, capacitance and dielectric constant measurements are usually made with bridge circuits and are the quantities which provide information regarding the characteristics of a dielectric.

Definitions

The dielectric constant of a dielectric material is that property which determines the electrostatic energy stored in the material per unit volume per unit potential gradient. For these purposes the dielectric constant is the ratio of the equivalent parallel capacitance of a capacitor in which the material is the dielectric, measured at the specified frequency, to the capacitance of the same capacitor with air as the dielectric.

The dielectric phase angle is the angular difference in phase between the sinusoidal voltage applied to the dielectric and the component of the resulting current which has the same frequency as the applied voltage.

The dielectric loss angle is the difference between ninety electrical degrees and the dielectric phase angle.

The dielectric power factor of a material is taken as the cosine of the dielectric phase angle or the sine of the dielectric loss angle.

The dielectric loss factor of a material is the product of its dielectric constant and the tangent of its loss angle.

The insulation resistance between two electrodes is the ratio of the voltage applied to the electrodes to the total current which flows between the electrodes.

The volume resistance between two electrodes is the ratio of the electromotive force applied to the electrodes, to the current which flows through the volume of the insulating material.

Volume resistivity is the resistance between two electrodes which cover opposite faces of a centimeter cube provided there is no surface layer or that the resistance of the surface layer is so high that no appreciable part of the current flows through it.

60-Cycle Power Factor and Capacitance Measurements

Dielectric power factor and capacitance measurements are made with an alternating-current bridge of the Schering type. A front view of this bridge is shown in Figure 1 and the circuit diagram is shown in Figure 2. This bridge is designed for operation at 60 cycles,

Fig. 1. Schering Type Alternating Current Bridge.

but measurements can usually be made at frequencies between 25 and 70 cycles. This instrument as used is combined with a 25 kv. shielded air capacitor, C_1, (Fig. 2) and an unknown capacitance, the test sample, C_2. Figure 2 also shows the supply transformer. The maximum voltage which can be used in testing is determined by the rating of the standard capacitor or sample C_1A. The minimum voltage is determined by detector sensitivity. The minimum capacitance, C_2, which can be measured is fixed by either detector sensitivity or the difficulty of defining small capacitances by means of shields. If the capacitance to be measured exceeds 1000 times the standard capacitance C_1, it is advisable to use an external shunt of known characteristics in place of R_3 in the bridge circuit (Fig. 2). The terminal marked "S" on the bridge is connected to one potential terminal of the shunt and the bridge ground terminal to the other potential terminal. The R_3 and R_4 arms are decade resistors adjustable to 11,110 ohms. C_4 is a mica decade capacitor adjustable in 0.001-microfarad steps to 1.11 microfarads, in parallel with a variable air capacitor. C_3 is a fixed mica capacitor which may be switched into the circuit when necessary to obtain a balance at very low power factor.

The bridge balance detector is a vacuum tube amplifier and alternating-current microammeter of the copper-oxide-rectifier type. The detector including batteries is enclosed in a metal box which is connected to one of the output corners of the bridge; thus admittances within the detector do not affect the bridge arms. The amplifier is substantially bifilar in arrangement so that its mutual inductances to external circuits are in general negligible.

There is a current-actuated shunt in the amplifier output circuit which serves to change the detector scale law and incidentally to protect the microammeter from large voltages due to accidental bridge unbalance. The detector sensitivity is unimpaired up to about one-third full scale. Above this point the shunt comes into effect gradually, thus making the detector progressively less sensitive. This behavior greatly facilitates the operation of balancing the bridge by removing the necessity for frequent adjustments of the amplifier.

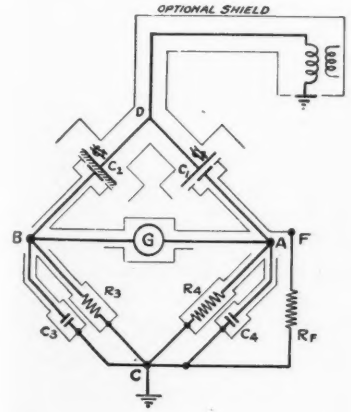


Fig. 2. Wiring Diagram for Schering Bridge.

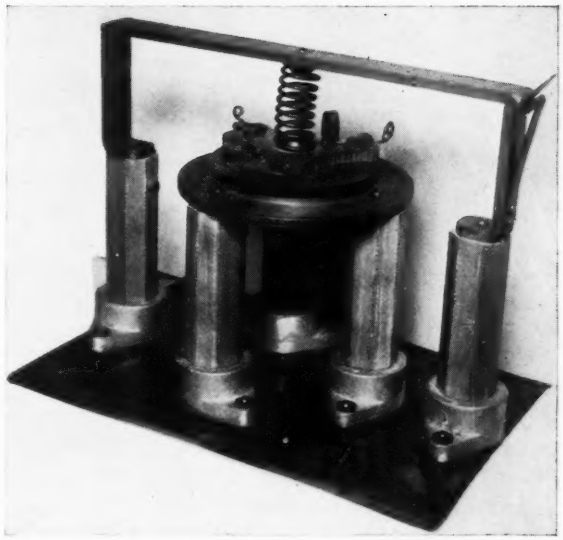


Fig. 3. Original Cells Used to Apply Voltage.

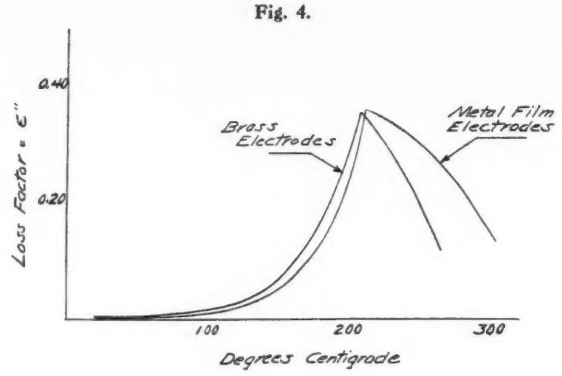
Errors in power factor measurement will not exceed 0.0002 power factor or 2% of the power factor to be measured, whichever is the larger. Accuracy to 0.0001 power factor may be expected through a restricted range. To secure this accuracy, the unknown capacitance of the dielectric must lie between 50 and 1000 microfarads and the shielding of leads from the bridge to the standard and unknown capacitors must be complete.

In order to make measurements with this bridge of power factor and capacitance of a dielectric, electrodes must be used so that voltage can be applied to the sample. The original cell is shown in Figure 3 in which brass electrodes are mounted on mycolex supports with a spring and clamp to insure good electrical contact. This cell is satisfactory for use at room temperature. However, as one investigation involved making measurements on samples of glass up to temperatures of 300 C°, a cell was constructed which is satisfactory in operation up to several hundred degrees Centigrade.

The guard ring and low-voltage electrode are held in position in the cell shown in Figure 3 by a bakelite strip. In the cell used at the higher temperatures this bakelite strip was replaced with a Pyrex disc. Then instead of mounting the high-voltage electrode on mycolex pillars a porcelain insulator was used. A weight system has been devised which puts pressure on the electrodes so that the contact will be reasonably good and so minimize air films between the electrodes and the sample whole electrical properties are to be determined.

When dielectric loss measurements are made with variable temperatures the cell containing the sample is placed in a thermostatically controlled oven. This oven is heated electrically and has a large blower which minimizes temperature gradients. Thermocouples are placed in the electrodes so that a good indication is

Fig. 4.



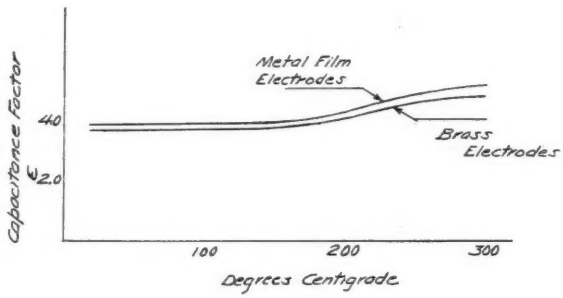


Fig. 5.

had of the temperature of the sample undergoing test. The thermocouple EMF's are picked up by a standard Leeds and Northrup potentiometer indicator from which conversion is readily made to degrees.

An interesting investigation was made on the effect of air films and the way in which they affect dielectric loss measurements. Any mechanical system which utilizes pressure on the electrodes between which the dielectric sample is placed obviously leaves films of entrapped air. The loss measurements then include air and the specific dielectric in series. Since the solid dielectric is the sample under the test the presence of air films in the measuring circuit gives rise to incorrect results. A method will be described which eliminates these air films and hence gives values of dielectric loss which are representative of only the test sample.

The means used to eliminate air films between electrodes and test sample is the process developed by the Ithaca Evaporated Metal Film Company. A piece of Borosilicate glass, which was the dielectric in this case, was coated on both sides with a metal film by an evaporation process under high vacuum. The metal film then comprises the electrodes and air films are nonexistent. Electrical contacts were made to the metal film through Aquadag which is a colloidal graphite solution. In order to get a comparison of results the curves of Figure 4 show the variation of Loss Factor and Capacitance Factor with Temperature using polished brass electrodes and metal film electrodes. The variation for the two types of electrodes is slight at low temperatures, however over the entire temperature range the effect of air films is evident.

The ordinates, Capacitance Factor e′ and Loss Factor e″, of the curves in Figure 4 are determined from the balanced bridge readings and by computation. The loss factor e″ is a scalar coefficient and can be determined either from an equivalent electric circuit or directly from the physical dimensions of the material being measured, the voltage applied and the power dissipated.

It has been found convenient to interpret all bridge or substitution measurements on dielectrics in terms of the equivalent parallel circuit of the measuring equipment. The complex expression for the admittance of the measuring circuit is given by

$$\frac{1}{Z} = G_2 + jw\,C_2 = w\,C_v\,(e'' + je') \quad \text{.....(1)}$$

where

G_2 = equivalent parallel conductance of the sample

C_2 = equivalent parallel capacitance of the sample

$w = 2\pi f$; f = frequency in cycles per second

$j = \sqrt{-1}$

$C_v = 0.08842 \times 10^{-12}(a/1)$ = capacitance of the same geometric arrangement of electrodes in vacuum, when a = effective cross-sectional area of the sample in square centimeters and 1 = effective thickness of the sample in centimeters.

From equation (1)

$e' = X_c/C_v$ (Dielectric Constant) .....(2)

$e'' = G_2/w\,C_v$ (Loss Factor) .....(3)

If it is desired to correlate the loss factor (e″) with the dielectric constant (e′) and the power factor (PF) the following relation is used:

$P.F. = \cos \cot^{-1}(e''/e')$ .....(4)

For good dielectrics which are low-loss materials the cosine and cotangent are approximately equal and equation (4) reduces to

$P.F. = e''/e'$ .....(5)

D. C. Measurements

The specific resistance or resistivity of a dielectric is determined, of course, with direct current. The standard voltage used in resistivity determinations is five volts per mil thickness of dielectric. As the glass samples used in the a-c. tests have a thickness of nearly 200 mils it is necessary to have a d-c. voltage of about 1000 volts. This is supplied from a rectifier while the direct current which passes through the dielectric is measured with a Vance amplifier. It is necessary to resort to special current measuring devices because the resistivity of glass is of the order of 10^{12} ohms per centimeter cube. The Vance amplifier is capable of measuring currents of the order of 10^{-10} amperes so it is well suited for dielectric resistivity measurements.

(*Continued on page* 28)

THE WORK OF THE U. S. GEOLOGICAL SURVEY

A Plea for the More General Use of Available Basic Data

By ARTHUR W. HARRINGTON, '09 C.E.

THE engineer deals with natural phenomena and his activities are predicated on the laws of nature. Whatever line of engineering activity he may follow, his completed work has been the result of a building-up process, starting with the simplest considerations and working toward a conclusion that often is highly complex.

In the early days of engineering, before experimentation had progressed very far and before any considerable amount of basic data was available, engineering work was largely a cut and try process, with strong emphasis laid on the personal opinion or experience of the engineer in charge. This situation has now radically changed and the modern engineer has at his command a vast amount of basic data which enables him to attack a problem with confidence and assurance.

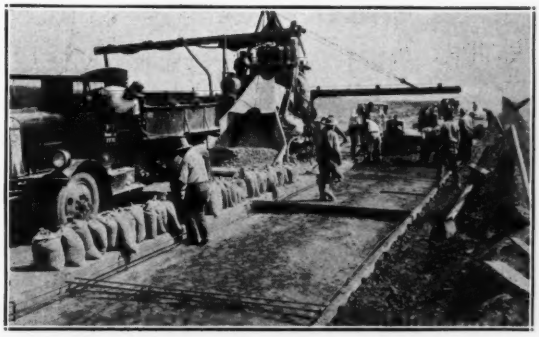
Many Federal agencies (and some state agencies as well) have been engaged for a long time in the collection of basic data for the use of engineers and other interested parties, and most of this information may be had practically free upon request. The Federal government has thus provided for the use of the engineer records and data for the whole United States most of which could not have been obtained in any other way.

The Geological Survey may be cited as one Federal agency that is engaged in the investigation of the country's natural resources and in furnishing information regarding those resources for the benefit of the public. This agency was created March 3, 1879, and, as may be inferred, the original purpose of the bureau was the systematic study of the geology of the United States. Additional functions gradually came into being, however, so that for many years the name of this important activity of the Department of the Interior has given little indication of the scope of the work which it carries on.

At the present time, the activities of the Geological Survey are divided among five units, the Geologic, Topographic, Conservation, Alaskan, and Water Resources branches.

Geologic Branch:—The Geologic Branch includes several sections: those of applied geology investigate metalliferous, nonmetallic, and mineral fuel resources; the others cover the fundamental subjects of petrology, mineralogy, paleontology, physiography, geochemistry, and geophysics. The problems of these sections can not be sharply separated, as the economic geologist not only requires the aid of those engaged in fundamental work, but also contributes substantially to our knowledge of fundamental geology, particularly the origin of mineral deposits, igneous and sedimentary rocks, and land forms. The Geologic Branch is the geologic consultant and makes special investigations for other Federal bureaus such as Reclamation, Indian Affairs, and Mines, Forest, National Parks, Public Health, Army Engineers, and Post Office Inspection Service.

The main results of its investigations are published as professional papers and bulletins; by-products, whether of fundamental or applied scope, may be pub-



Topographic Data Aid in Location of Suitable Highway Sites, Such As This One Under Construction in California.

lished in technical journals. Some of its projects are conducted in cooperation with State organizations, and the resulting reports may be published by the States.

Although this branch consists of several sections, the field studies of individual geologists in each section embraces problems that fall within the scope of several sections. For example, in surveys of oil and gas fields, or of undeveloped areas favorable for testing for oil, or of coal fields and areas known to be underlain by coal-bearing rocks, the geologists study and map the different formations, collect fossils, give attention to the physiography, and indicate structural and stratigraphic conditions that control the accumulation of oil and gas. In the study of mining districts, the general geologic features as well as the mineral deposits themselves must be thoroughly studied and the results applied to the determination of the origin of the deposits, their persistence both horizontally and in depth, factors that will aid in the search for additional deposits, and the mineral reserves that may be expected under different market conditions.

Topographic Branch:—The work of this branch consists principally of field surveys and the subsequent preparation and publication of the well known topographic maps which will eventually cover the entire country. The scale of the finished maps is most generally 1/62,500 or approximately 1 mile to an inch, although various other scales are used. Geological Survey topographic maps are so well known that no further description is required. Over 4,000 of these maps have already been issued. They are indispensable for national defense, for engineering design, and for numerous other public and private uses.

Conservation Branch:—The work of this branch "involves surveys and investigations for an inventory of the water and mineral resources of the public domain, supervision of private development of power and production of minerals from public and Indian lands and naval petroleum reserves, and supplying information and advice to numerous land-administrative agencies of the Government."

Revetment of Spruce Trees for Protectng Stream Bank

True conservation implies wise and far-seeing development and use of the mineral, water, and agricultural resources of the remaining public land. Such development is principally through leasing, with operations under the supervision of the Conservation Branch. By such an arrangement much revenue has accrued to the Federal government. At the same time, under the careful supervision which is exercised, no serious waste of natural resources has occurred.

Alaskan Branch:—The work of the Geological Survey in Alaska follows along the same lines as in the States, but for geographic and other reasons these activities have been concentrated in a separate branch. Alaska is still a relatively unexplored region and even now more than 300,000 square miles remain entirely unsurveyed. As a matter of fact, much less than one percent of the area of Alaska has been adequately mapped from a topographic or geologic standpoint. The Alaskan Branch is thus a clearing house for information of all kinds concerning the vast natural resources of this area. Such information has supplied the ground work which has been preliminary to many of the mining developments that have already yielded minerals to the value of 100 times the original price paid to Russia for all of Alaska.

Water Resources Branch:—This branch conducts field investigations and publishes systematic records of the quantity, chemical quality, and availability of both surface and ground waters. Because of the importance of water in connection with every human activity, the necessity for full knowledge concerning it is self-evident. It has been repeatedly shown that the experience of the past furnishes the most dependable guide for the future. The work of this branch provides a record of past performances which has proved its value as the most reliable indicator we have as to what may be expected in the future.

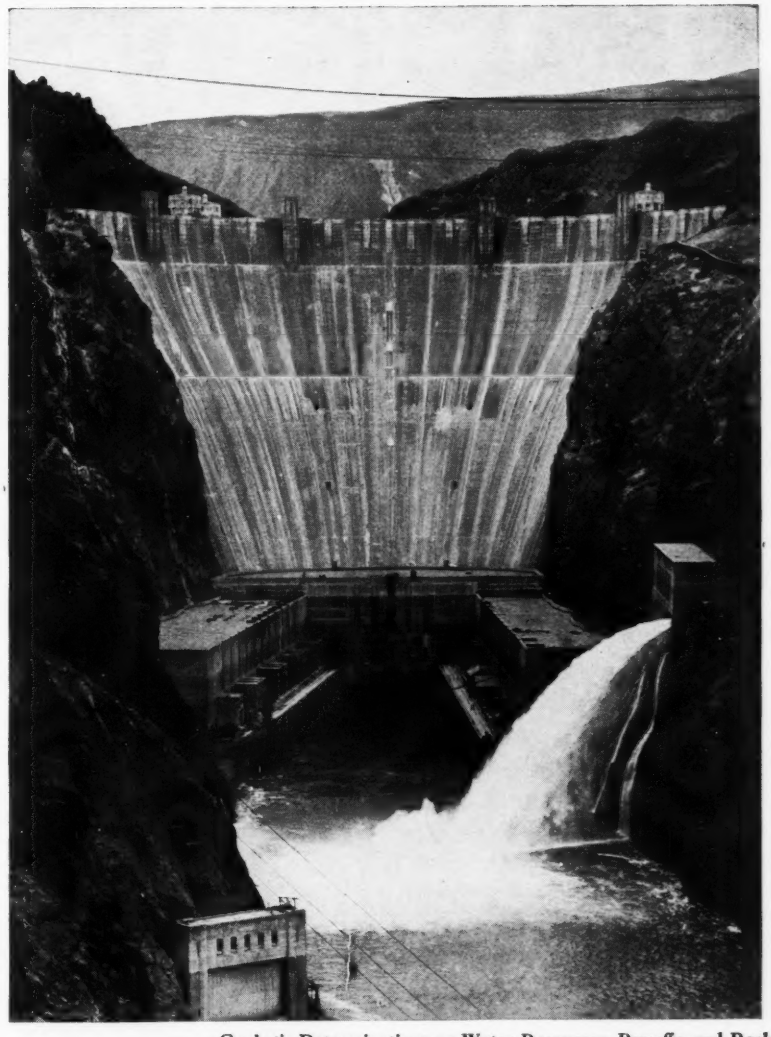
The Division of Surface Water through 37 district offices conducts investigations of surface water which consist in the measurement of stages and discharges of selected rivers and streams in 47 states, in the District of Columbia, and in Hawaii. At present over 4,000 gaging stations are being maintained in the United States, records from which are published annually in the Survey's Water-Supply Papers.

The Division of Ground Water investigates the waters that lie below the surface in the zone of saturation from which wells and springs are supplied; the source, occurrence, and quantity of those waters; their conservation and availability for domestic and industrial use and for irrigation. Such information is made available to the public in Water-Supply Papers and by numerous technical papers and reports. During 1939 about 75 technical papers and reports on ground water were released to the public by the Geological Survey.

The Division of Quality of Water makes analyses of both surface and ground waters with reference to their suitability for industrial and agricultural uses and as domestic supplies, so far as such use is affected by dissolved mineral matter. It also makes studies of the suspended and dissolved matter in certain streams. It is coming to be generally recognized that the chemical quality of available water is a most important consideration in the selection of sites for industrial plants, and the reports of this division are of great value in that connection.

The Division of Water Utilization conducts hydrologic studies and compiles data relating to the utilization and control of the waters of streams. In effect therefore, this division carries the work of the Division of Surface Water one step farther and makes available to interested parties special studies of many kinds. Much work has been done of late in tabulating data on floods, which information is in great demand because of the impetus which flood control work has received during the past five years.

The Water Resources Branch is at present actively engaged in investigational work in New York State where cooperative stream gaging has been carried on almost without interruption for nearly forty years.



Geologic Determinations on Water Resources, Runoffs, and Rock Foundation Played Vital Factor in Location of Boulder Dam.

The Water Resources Branch is at present actively engaged in investigational work in New York State where cooperative stream gaging has been carried on almost without interruption for nearly forty years. Continuous records of daily discharge are now being obtained at more than 160 gaging stations. These include records on the principal larger streams as well as on many of the smaller streams where records are required by various state agencies, by the Army Engineers, by counties, by Regulating Districts, or by municipal agencies, notably the Board of Water Supply of the City of New York.

Daily discharge records are now available at many stations in the state for periods of over twenty-five years, during which time floods and droughts have occurred several times. There is thus available a record of past performances which gives a most valuable indication of the extremes of flow which may be expected in the future. The great value of a stream flow record obviously lies in its continuity over a relatively long period of time.

The stream gaging work carried on in New York is conducted from the district office in Albany and from two sub-offices, one in Binghamton and the other in Ellenville. The Binghamton sub-office provides data on stream flow from 46 stations, which are used, among others, by the Army Engineers in their flood control program which is now well under way in the upper Susquehanna River basin. The Ellenville sub-office furnishes similar information to the New York City Board of Water Supply, which is now engaged in construction work for providing a large additional water supply for New York City. Data from the Albany office and both sub-offices are, of course, as available to any interested party as to the cooperating agencies.

(*Continued on page* 24)

NEWS OF THE ALUMNI

Cornell engineers will be interested in the candidacy of Willis H. Carrier, '01, for alumni trustee of Cornell University. Two alumni trustees are to be elected by ballot before June 10, 1940 for five-year terms; all persons holding degrees from Cornell are eligible to vote. Mr. Carrier is the only engineer in the group of four candidates for these two important positions.

Mr. Carrier's contributions to the advancement of the engineering profession are well known. He has held many important offices in the A.S.M.E., the A.S.H. and V.E., and the A.S.R.E. He was awarded the John Scott Medal for the invention of processes and apparatus for air conditioning and refrigeration, the F. Paul Anderson Gold Medal for distinguished scientific achievements in the same field, and the 1934 Medal of the A.S.M.E. American industry recently honored Mr. Carrier by choosing him as one of the nineteen Modern Pioneers "whose achievements have made our American industrial system the envy and example of the world."

Mr. Carrier has always been actively interested in the affairs of Cornell. As an undergraduate, he was a working student but went out for freshman crew and participated in intramural crew and cross-country. At the beginning of his senior year, he and a classmate bought out a laundry route on the campus; this was the beginning of the Student Laundry Agency at Cornell. Since graduation, Mr. Carrier's advice and help have frequently been sought for and received by members of the instructing staff of the Engineering College. He was elected to Sigma Xi in 1914 and to Tau Beta Pi in 1938. He is now serving as President of the Cornell Society of Engineers and as a Vice-President of the Cornell Alumni Fund.

Carlos D. Hart, a graduate of the College of Engineering in the class of 1906 who is now superintendent of the Wire Products Shop of the Western Electric Company, addressed senior mechanical and electrical engineers at Cornell Friday, March 29. His subject was, "Production and Control Problems."

Hart is superintendent of cable manufacturing for the Western Electric Company at the plant in Point Breeze, Maryland. During his service with the company, which began immediately upon graduation from the College of Engineering, he has been stationed at the New York plant, the Hawthorne works, and various other branches in this country and for two years was superintendent of the installation of telephone cables in Japan. He has also travelled widely in Europe and other parts of the world to study foreign methods. With Professor John R. Bangs, Jr., of the College of Engineering, he is co-author of "Factory Management," published by the Alexander Hamilton Institute.

WILLIS H. CARRIER, '01

A frequent visitor to Cornell for many years as a lecturer and employment representative, Hart has a deep interest in the University. One of his sons holds a Cornell degree and another is now a student in the College of Engineering.

Mrs. Olive W. Dennis, '20, was given special recognition, "as the only woman member" of the American Railway Engineering Association at the annual meeting held recently in Chicago. She serves on the Economics of Railway Location and Operation Committee of the society. Mrs. Dennis is with the engineers' service of the Baltimore and Ohio Railroad Company.

Use The Cornell University Placement Bureau

WILLARD STRAIGHT HALL — H. H. WILLIAMS, '25, Director

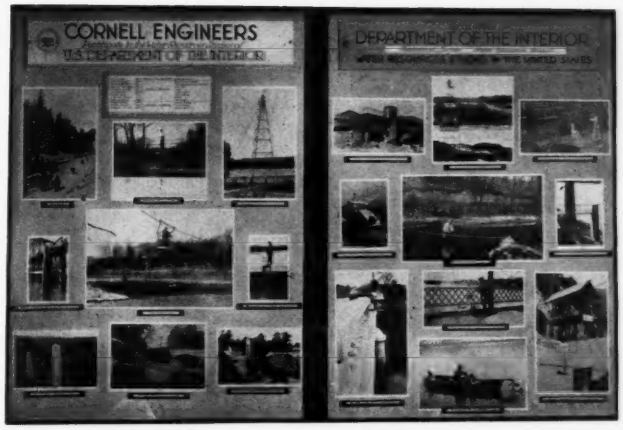
Kenneth Alan Browne, former instructor in the School of Electrical Engineering, has been awarded the Wright Brothers Medal for 1939 for his paper, "Dynamic Suspension—a Method of Aircraft-Engine Mounting." The medal was presented at the recent Society of Automotive Engineers' national aeronautic meeting. Browne's paper was adjudged the best "on aerodynamics or structural theory or research, or airplane design or construction," of any presented at an SAE meeting during 1939. When the medal was presented, the importance of the development described in Mr. Browne's paper in reducing aircraft vibration by isolating the engine vibration from the remainder of the airplane was emphasized.

Browne is now project engineer for the Wright Aeronautical Corporation, working exclusively on new development in the Research Department. After graduating from the University of Colorado in 1926, he studied for one year in the College of Arts and Sciences, Cornell University, and then served for two years as an instructor in the Electrical Engineering laboratory while taking advanced courses in engineering. In 1929 he entered the employ of the Curtiss Airplane and Motor Company, as an observer in the Experimental Engine Department, and shortly after went into test engineering work, both at the factory and in flight. In 1931 he was transferred to the Wright Aeronautical Corporation, where he first carried through the design and development of a gasoline fuel-injection system for aircraft engines. In 1934 he assumed his present duties.

Gladyce Tapman, a graduate of the School of Civil Engineering in the class of 1934, is the only woman among more than a hundred engineers making designs for details of the East River Drive in New York City. The story of her career was featured in the New York Times for March 31.

Entering Cornell in 1929 as a student in the College of Arts and Sciences, Miss Tapman soon decided that she preferred engineering and transferred to the Civil Engineering School, securing her degree three and a half years later. Before the rest of her classmates were graduated, she was working in a field office on a Mississippi levee at Quincy, Ill., where a lock and dam were being constructed under the supervision of army engineers. Her job was estimating the tons of steel and cubic yards of concrete needed to carry out the plans.

In a civil service examination held a year ago, she was one of 1,500 applicants, and also, one of the 250 who passed. Her first assignment was to prepare estimates on an air-conditioned sanitation dump, which is now being built at Ninety-first Street and the East River, at a cost of half a million dollars. The record of costs and quantities of materials to be used in its construction, including steel, concrete, corrugated glass and transite, a composition for the walls, fills a sizable volume.



U. S. DEPARTMENT OF INTERIOR
(Bureau of Reclamation)

John C. Page '14 C ..... Commissioner, Washington, D. C.
William G. Beatty '03 M .. Designing Engineer, Denver, Colo.
James H. Miner '00 CE .. Office Engineer, Grand Coulee Dam, Washington

U. S. DEPARTMENT OF INTERIOR
(Geological Survey)

John C. Hoyt '97 CE .. Consulting Engineer, Washington, D. C.
Robert Follansbee '02 CE . District Engineer, Colo., Wyo., Neb.
Arthur W. Harrington '08 CE .... District Engineer, New York
George H. Canfield '10 E ..... District Engineer, Oregon
Lynn Crandall '10 CE ..... District Engineer, Eastern Idaho
William Kessler '13 CE ..... District Engineer, West Virginia
J. Holloway Morgan '13 CE ..... District Engineer, Illinois
Berkeley Johnson '20 CE .... District Engineer, New Mexico
William G. Hoyt '09 CE .. Hydraulic Engineer, Special Studies
Hollister Johnson '12 CE .. Hydraulic Engineer, Flood Studies
Medford T. Thomson '25 CE .. Hydraulic Engineer, New Eng.
Albert H. Horton '98 CE ..... District Engineer, Middle Atlantic States

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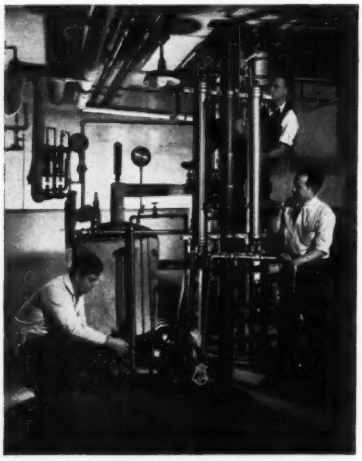
Four men who received their civil engineering training at Cornell are mentioned in a current bulletin of the U. S. Coast and Geodetic Survey. E. W. Eickelberg '13 is in command of the ship *Guide,* which during February went to the harbor at Seattle, Washington, for annual repairs. A. M. Sobieralski '08 will assume command of the *Explorer* as soon as it is commissioned. He has been in charge of builders' trials, as inspector of construction on the new ship. Joseph M. Smook '20 is working on the field records of the *Surveyor, Discoverer,* and *Westdahl* at the processing office in Seattle.

Herman Odessey '17, executive officer of the ship *Pioneer,* died suddenly at Oakland on February 5. He entered the service in August, 1917, and was six years in the Division of Goedesy, served as executive officer of four ships, and acted as commanding officer of the motor vessel, *Gilbert,* for five years. He is described in the government publication as "a capable and conscientious officer, enjoying the highest confidence of his superior officers."

(*Continued on page* 24)

Spring. Surveyors with their transits (their uses are many)—more and more dogs on the quadrangle—the cigarette sessions in front of Sibley at between-class time—and, of course, the coeds. That is spring at Cornell. It's a very pleasant season—no ice, no heavy overcoats to stagger under, and an excellent time of the year in which to get completely lazy ("spring fever" seems to be as good as any of the current rationalizations).

My Bulova says 10 o'clock—my single dead hour of the week. How about taking a walk around the engine campus with me and see what's going on? There's Joe Coors over in front of West Sibley talking



Small Scale Fractionaling Equipment Exactly Duplicating Larger Equipment Used In Oil Refineries.

with Beach Barrett and Bob Ross. A slide rule won't be needed to figure out what they're talking about. Joe is running the engineering show this year and Beach is in charge of publicity, while Bob has tackled the job of planning the program. The subject is obvious. From their talk we learn that the show will be held on May 4th with a program bigger and better than that of last year. As Beach describes it, "quantity with quality". One essential change from last year's program has been made: there will be no individual demonstrations on Friday night, but instead there will be a talk at Bailey Hall which will be of special interest to the Cornell Day guests. On Saturday the proverbial lid will be off and the show will be in full swing. The men in charge of the various exhabits are: Chem. E, George Gentes; ME, Trav Nelson and Dean Wallace; EE, Crawf Adams, Ed Clayton, and Ed Friedrich, and CE, H. W. Lansing and Paul Swatek. The Chem E's are preparing several exhibits of unusual interest. The main demonstration will be one which depicts the preparation of Orange II, a dye, starting on a laboratory scale and building up through the semi-plant operations. Other demonstrations of interest will be those illustrating chemical

NEWS OF THE

microscopy and metallography. The ME's have combined their efforts to produce a good-sized exhibit which will include the center piece of the whole show, the illuminated fountain. The color of the lights playing on the fountain are controlled by the frequency of the sound waves emanated from amplified recordings, producing a rather interesting effect. Inside the mech labs, motors of all sorts and manner will be operating, including the Corliss triple-expansion steam engine. Cornell's air-conditioning experts have set up a room whose temperature will be 40°. If any of the visitors care to experience a bit of the well advertised Finnish weather, the opportunity awaits them. Over in Franklin Hall, the guests will receive many electrical surprise packages (no shocks, we assure them). The EE's did their level best to set up an electrical chair, but the idea had to be dropped because there were no volunteers for the position of testing the thing. Nevertheless, they have set up a well integrated show, leaving out no aspect of electrical engineering. Tests of A. C. and D. C. motors will be conducted along with exhibits demonstrating a good many electrical effects. Lincoln Hall, the home of Cornell's civil engineering school, will be decked out in full glory and she will have the privilege of proudly presenting their newest testing machine. Down in the materials testing lab, the spic and span steel and concrete tester, capable of exerting a 400,000 pounds pressure, stands "undressed" awaiting the close observation of visitors. A window has been placed behind the panel which contains the hydraulic apparatus used in measuring the force exerted by the machine. Many other shows in Lincoln Hall will be of equal interest. In the cement lab a piece of equipment used to maintain concrete specimens at uniform temperature and humidity while curing should

Surveyors Do ary Slop

F THE COLLEGE

attract interest; also, the photoelasticity department has arranged a show of unusual merit. In this latter exhibit, stress and strain studies are made with the aid of polarized light and test specimens composed of a plastic substance. All visitors will be conducted by student guides, and that will really be a help, for there is much to see and without proper guidance, many important aspects of the exhibit would be missed.

At this point, the trio's conversation is turning to the time they had at the Engineer's Ball which took place on April 19th, a Friday night. The Memorial Room of Williard Straight was transformed into a cabaret for the occasion and the idea really clicked. And they say that engineers lack originality. As the conversation is turning to more personal topics, it is about time we moved on.

As we turn around and head towards Lincoln Hall, whom do we almost bump into—Dean Hollister. We remember that we're on good terms with the dean these days, having passed all the required subjects, and so we feel completely free to talk with him—after all, even a busy dean enjoys a few moments of this spring air. We find the talk shifting to the recent Honors Day Dinner and the men who have achieved recognition for their scholastic standing. We learn that there were 140 men who had maintained an average of 85 or better, which, the Dean reflects, isn't too bad, but could stand improvement. We agree. We also are told a few things about the program of the banquet on May 1st. Dr. Day gave the main address and Mr. Carrier, one of our most famous alumni, awarded the Cornell Society of Engineers prizes to the two top sophomores in each school. These were: CE, Mateo Lin Poa Go and Donald Robert Goodkind; EE, Harry Jeannot Lipkin and Francis Brendan Burke; ME, Abbott Allen Putnam and William Hyman McDonald Jr.; and ChE, William Henry Tilley and James Morgan Davison. The Sibley Prizes were awarded in the following order: Crawford Granger Adams, first, William Dean Wallace, second, David Morris Bradt, third, Martin Goldstein, fourth, and Beach Barrett, fifth. The Fuertes Undergraduate Medal in Civil Engineering went to Edwin Paul Swatek Jr. '40, and the Kappa Tau Chi Award to David Joseph Coons '43 AEME. From our discussion we learned some pleasing news. The award of 22 additional McMullen Undergraduate Scholarships of $200 each was approved by the Board of Trustees of the University. These scholarships are available to students in engineering who have satisfactorily completed the first year and can show definite financial need. Applications are received through the directors of the respective schools in which the students are registered. At this point the Dean looks at his watch and intimates that enough has been said. We acquiesce and bid him goodbye. And away we go again, but

Administrative Engineering Exhibit, Cornell Day 1939

at this point we veer from the direction of Lincoln and head towards J. P. for refreshments.

The walk from Sibley to Johnny Parson's proves uneventful except for a reflection as we pass over Triphammer Bridge: what a spot for a high dive! As we sit down in Johnny's for a coke or what have you, we notice the faces of George Vreeland, George Mueden, and True McLean (the accumulation is hypothetical) peering through the blue haze of cigarette smoke. Sensing the possibility of some "scoop" news on the activities of the various societies, we move *en masse* to the corner. The waitress is kind enough to bring our orders to us and we proceed to question these men. George Vreeland of the ASME tells us that a trip to the Corning Glass Works was made, and, of course, the mould for the famous 200 inch mirror was the highlight. The local ASME speaking contest resulted in victory for Charles W. Lake Jr. and a second place for a well-known ME, Barbara Hart. Chuck spoke on the demobilization of industry while

(*Continued on page* 30)

Surveyors Do ary Slope Again

CORNELL SOCIETY of ENGINEERS

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PAUL O. REYNEAU '13, Secretary-Treasurer
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HERBERT B. REYNOLDS '11, Recording Secretary
New York, N. Y.

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students, and to establish a closer relationship between the college and the alumni."

President's Message

Fellow Engineers:

Since this is the last letter I shall write for this column due to the expiration of my presidential term, I wish to take this occasion to emphasize the actual and potential value of this Society. The purpose of this Society cannot be better expressed than in the quotation from its constitution appearing at the head of this column. Since this statement is general, I wish to elaborate it by some concrete examples of services which this Society is in a position to render. These services may be listed under five headings: (1) Social Service . . . Promote Recognition of its Obligations; (2) Aid to Cornell in Engineering Leadership; (3) Aid to Continued Improvement in Quality of Cornell Engineering Graduates; (4) Placement of Graduates and Alumni; (5) Stimulation of Engineering Alumni Interest to Attain these Ends.

Social Service

The foundation of our modern material civilization is definitely based on the practical application of the exact sciences to industry . . . that is, upon technical development. In this technical development, engineering in its various branches dominates the whole. For this reason, great social responsibility rests upon the engineer. He must be awakened not only to his opportunities, but to his increasing social obligations. He must become more than a tool in the hands of the user. Cornell engineers should receive inspiration and assistance through their association in this Society to take their rightful place in this social movement. In this field, as well as in narrower technical specialities, they should reflect credit upon their alma mater.

Leadership in Engineering Education

Cornell engineering alumni with their seasoned experience as engineers and employers, can render great service to Cornell . . . not only as advisers to her faculty, but in the education of prospective students and their parents as to the true aims and methods of a technical education, so that the demands made upon the University may be for broad engineering training, rather than specialized training in the undergraduate years.

There now exists a definite organization for this purpose, since an Engineering Council has recently been established at Cornell. This consists of eight eminent engineers, appointed by the Board of Trustees, in addition to which Past President Walker L. Cisler, represents this Society on the Council.

Continued Improvement in Quality of Cornell Engineering Graduates

The prestige of a university is determined by the quality of its engineering graduates. To this end, two things are necessary in our engineering college: (1) The soundest possible instruction in basic engineering principles; (2) Selective admission which will provide an undergraduate body most capable of benefiting by such instruction and who have the ability and personality to become a credit to the university. Dean Hollister is formulating a plan through which The Cornell Society of Engineers and other alumni will render assistance in the local selection of candidates for admission. In this important service, members of our Society will have an opportunity to do a great service for Cornell. *The purpose of this activity is not to produce a larger school of engineering at Cornell, but a better one.*

Placement

During the past few years, an excellent placement service has been operated by the University Placement Bureau, headed by Mr. H. H. Williams in co-operation with Prof. John R. Moynihan, Personnel Adviser for the College of Engineering. This Placement Bureau includes a field organization of seventeen alumni in various industrial centers and an affiliated office at The Cornell Club in New York City under the direction of Mr. Paul O. Reyneau, Secretary and Treasurer of this Society. The management of the New York Office is a full time job; and here, as at Ithaca, much valuable work is being done . . . not only in actual placement which has been most effective, but in vo-

(*Continued on page* 30)

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When you send your voice by telephone, it arrives in perfect shape

Back of the good service which your Bell Telephone Company gives you is the equipment you use. This is Western Electric's responsibility, as it has been for nearly sixty years.

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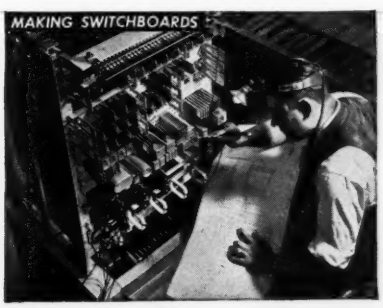
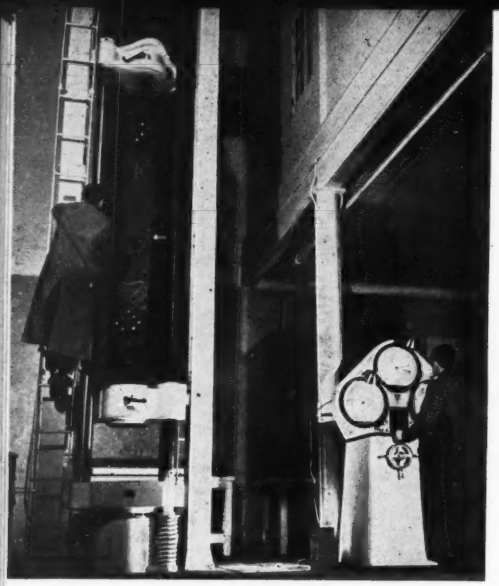
Thus Western Electric helps your telephone company to handle "Your Voice with Care" and to provide a service which is the best and most economical in the world.



Western Electric *. . . made your* ***BELL TELEPHONE***



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EDITORIAL

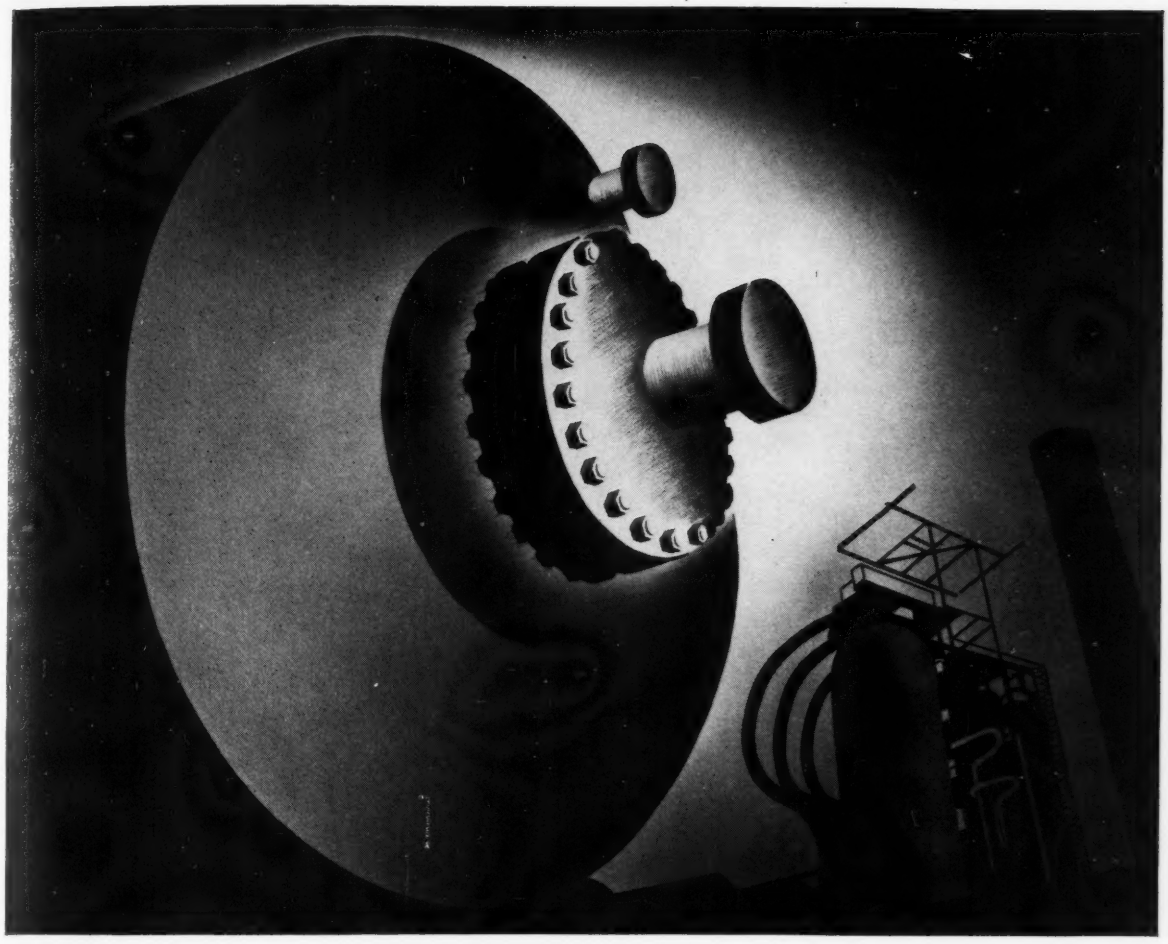
To many students Cornell Day is the time when the engineers stage their show. In order to make it possible for students to appreciate more fully the benefits of this show, the editor felt that a little of the background and history of the Engineering Show would not be untimely. Some changes have been made in the program and these will be explained in the editorial.

The generally accepted purpose of the Cornell Day Engineering Show is to give to the prospective engineering student an idea of, to quote from Dean Hollister, "What are the major fields of engineering, and what kind of training is offered at Cornell to fit students for positions of responsibility in engineering, business, and industry." For eleven years now, the engineering students with the help of the faculty have presented a show for the entertainment and instruction of visitors. The show was started in 1930 by the School of Electrical Engineering with the purpose of giving entertainment and instruction to the student body and general public. The show continued thus for five years until 1935, when it started to include the other engineering schools in the show, and it was run in conjunction with Cornell Day. During this time its purpose underwent a change to its present form.

In 1939, to satisfy the need of coordination, the Student Engineering Council was organized with student and faculty representatives from each of the four schools of engineering with the purpose of fulfilling the need for continuity of personnel and consolidation of effort in the running of the annual engineering show and in the raising of funds. This council has been meeting since the first of the term, and under its guidance this year's show has been planned. In addition to the grant it received from the student council, part of the necessary funds were raised by a dance sponsored by the council on April 19.

This year the show was planned for Saturday only. It was felt in the past that by running the show on Friday night, the trip through the schools in the morning was an anticlimax and it left the subfreshmen with little to do or see on Saturday. In place of the show on Friday night, a big lecture for everybody was planned for Bailey Hall, thereby saving the show for Saturday and saving much effort on the students' part. It was planned that while the subfreshmen were attending the rally on Saturday night at Bailey Hall, the public would attend the show, so that at no time would the crowds be too large.

These changes, it is hoped, will make the show more entertaining for the visitors and at the same time relieve those students and other men who work on the show of some of their strain.



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PRESENTING

James A. Frank, A.E. '40

The occasional visitor to Jim Frank's room might figuratively dub him the most broadminded engineer on the campus. The first thing that meets one's eye on entering is a wide sweep of windows that command views of the magnificent Cayuga valley in both directions. Sitting there in the pleasant spring sunshine, it is pretty hard to conceive how he can apply himself to the prosaic business of studying with such an inspiring panorama spread out before him. But Jim seems to have command of the situation, for his scholastic efforts have been rewarded by membership in both Tau Beta Pi and Kappa Tau Chi and the winning of a McMullen scholarship. Outside of Ithaca Jim doesn't let his appreciation of the pleasant way of living lapse. Sticking pretty closely to the old adage that travel broadens, he has spent the last three summers in an almost idyllic fashion in liesurely roaming about the country

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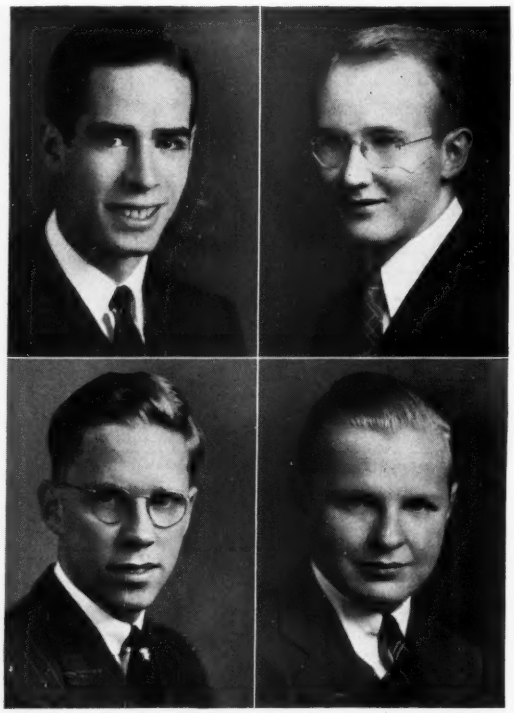

John E. Billings, M.E. '40

Is there a special Providence which watches over John Billings? During the summer following his freshman year, John was time-keeper and welder's helper for Babcock & Wilcox on a boiler construction job. John says he almost failed to return to Cornell for his sophomore year because that summer, while fixing the coupling on an air fan, a two-ton steel air duct slipped out of a hoist and landed within three feet of him. During the summers following his sophomore and junior years, he worked for the Lederle Laboratories, which manufacture pharmaceutical equipment.

John has been a member of Atmos, the Frosh Advisory Committee, and Secretary-Treasurer of the Cornell chapter of the ASME, which he represented at the Philadelphia Convention last fall. But he will be best remembered as Treasurer of the CORNELL ENGINEER, for he did a fine job in keeping the books.

Although very much interested in amateur radio, John finds that he does not have much time to devote to it while at school. During his leisure he plays golf or ping-pong. He has played football, softball, and

(*Continued on next page*).

Robert J. Reeves, C.E. '40

Although he has been last year's Managing Editor of the CORNELL ENGINEER, a member of Chi Epsilon, and house manager and steward of his fraternity house, Bob does not profess to be a BMOH. He claims that he does not come under that category—he refuses to permit anyone even to suggest the fact.

"Reevesy", as he is called by his fraternity brothers at Sigma Phi Epsilon, will be graduated from the School of Civil Engineering this June. Since he is interested in becoming an architect, he expects to enter the College of Architecture here at Cornell next fall and go ahead for three years to get his degree from that college.

His favorite hobby is bridge—his fraternity brothers report that he plays the game for hours at a stretch and never seems to tire of the subject. He and his partner finished 5th in the University Bridge Tournament which was recently held in Willard

(*Continued on next page*)

Robert G. Irish, A.E. '40

This spring when Bob turned over his duties to the new senior board he had completed four years of work on the editorial board of THE CORNELL ENGINEER. He was elected to the position of Associate Editor during his fourth year.

To explain Bob's reasons for coming to Cornell we have to go back a few years. In high school he became interested in radio and shortly after he obtained an operator's license. While engaged in his hobby he experienced many thrills, and strange as it may seem, his greatest thrill came not in talking to another "ham" in England as he did several times, but in talking with a girl operator in Rochester. His constant connection with electrical equipment soon turned into a desire to take electrical engineering in college. His father and mother, both Cornell graduates, had other ideas, however. They wanted him to have a business education so a compromise led to his present course of Administrative Engineering.

Bob spent the summer of his Junior year at the United States R.O.T.C. Camp where he had an excellent time both working and playing. The previous

(*Continued on next page*).

Robert G. Irish, A.E. '40

(*Continued from preceding page*)

two summers he spent at his aunt's farm. A little incident occurred during one summer which caused considerable excitement among the men. One of the farm hands suddenly became violent and Bob and his roommate happened to be the only ones around, so they had the job of trying to quiet him. They spent several anxious moments before help arrived, and needless to say he wouldn't care to have it happen again.

Bob is another example of one who can combine both scholarship and extra-curricular activities. He is in the upper quarter of his class and he has also found time for several activities besides his work on THE ENGINEER. These include: Advanced R.O.T.C., Officers Club, Pi Tau Pi Sigma, Pistol team, Amateur Radio Club, and Historian of his fraternity, Theta Chi.

He has no definite plans after graduation but hopes to obtain work in a fairly small city.

James A. Frank, A.E. '40

(*Continued from preceding page*)

and following his favorite hobby—fishing. His far flung itineraries have left him little time to spend at his home in Pittsburgh, but after all, you only live once.

With a sigh Jim admits that his vagabonding days are about over, for this summer he is slated to start work with a concern manufacturing steel wire. Being more interested in the business aspect of engineering, he hopes some day to attain an administrative position.

At Cornell Jim has gone ahead under full steam for four years and shows little sign of letting up very soon. Not only has he acted as the very capable Business Manager of the CORNELL ENGINEER for the past year, but has also served as a member of the Junior Smoker Committee and as president and treasurer of his fraternity, Zeta Beta Tau. Not content with resting on his oars for his last term, he is now hard at work as chairman of the Administrative Engineering committee for the Cornell Day Engineering Show and will soon start doing business as a team captain of the 1940 Memorial Fund Drive.

When not engaged at school work or official business, Jim dabbles in photography. Extensive practice in his summer jaunts seems to have been extremely worthwhile, for one of his prints has recently won first prize in the Senior Class Announcement competition.

Robert J. Reeves, C.E. '40

(*Continued from preceding page*)

Straight Hall. Another topic of diversion with Bob is outdoor activity. He is very fond of getting off by himself in the territory surrounding Ithaca and hiking

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to nearby spots. He claims to know almost every nook and cranny within a radius of ten miles from the University. In support of this interest, Bob took a camping trip last summer, covering points of interest from southern Virginia to as far north as Montreal, Canada. The remainder of last summer was spent at Ordnance ROTC Camp in Aberdeen, Maryland and at the Cornell Civil Engineering Surveying Camp along the shores of Lake Cayuta near Odessa, N. Y. In the two summers previous to this one, Bob has done jobs varying from surveying to computing data for an irrigation project in Colorado. Bob likes the landscape around his native Denver and hopes to be able to make a permanent home there in the near future.

John E. Billings, M.E. '40

(*Continued from preceding page*)

basketball on his house team, and he has also represented his fraternity in the intramural bowling events. John has served as Vice-President and as Rushing Chairman of his social fraternity, Pi Kappa Alpha.

John is one of ten men selected from the engineering schools throughout the country who will, after graduation this June, take a cadet training course sponsored by the Public Service Electric & Gas Company of New Jersey.

ALUMNI NEWS

(*Continued from page* 15)

Walker Wakefield Peterson, a Sibley graduate in the Class of 1911, was a guest of Dean Hollister March 24. His son, Walker Wakefield Peterson, Jr., is a junior in the School of Mechanical Engineering.

Furman South, Jr., of Pittsburgh, was in Ithaca for several days conferring with Dean S. C. Hollister and other members of the college staff. He is a vice president of the Cornell Society of Engineers and chairman of the Pittsburgh Regional Chapter of the Society.

Fifth edition of Principles of Industrial Organization, first written in 1913 by Professor Dexter S. Kimball, Mechanical Engineering Emeritus, has been published by the McGraw Hill Co. Dexter S. Kimball, Jr. '28 is co-author with his father on this edition. The book is used in sixty-five schools and colleges; has been translated into French, Czecho-Slovakian, and Spanish.

'93 ME (EE), '94-'98 Grad—William Vincent Kelley died on February 9, 1940, in Spokane, Wash., where he lived at 103 West Fourteenth Avenue. He was secretary of the Cornell Club of Eastern Washington and alumni representative for that area, traveling around to secure information for Cornell. He was a corporal in the Spanish-American War, then worked for the New York Telephone Company in New York City; later set up his own engineering business. In 1911 he moved to Spokane to operate a family wheat ranch near Oakesdale. He entered Mechanical Engineering in 1891 from City College of New York and received the "C" in track, lacrosse, and football. He was a lifelong friend of Glenn S. (Pop) Warner '94. Sons, William V. Kelley, Jr. '26, Thomas D. Kelley '31, and John F. Kelley '34; cousin, Coach John F. Moakley.

'15 ME—Christopher Magee, brother of Norman H. Magee '23, was with the Youngstown (Ohio) Sheet & Tube Co. until the War broke out, when he joined the Army and ended up as second lieutenant of aviation. After the War he went back to his job but lost it in 1928. He packed up his family, which then consisted of a wife and two daughters, set out for St. Jean de Luz in France, and stayed for three years, writing novels; but in 1931 returned to America and Adler Creek, near Utica. He bought a half-acre of land and "What was, by courtesy, called a house" and set about to rebuild it himself, making new additions as his family increased. The half-acre is now five and the house has three additions, with playhouse and garage; the garden has enough vegetables to last from spring until fall. His children number four, the youngest one born last May.

GEOLOGICAL SERVICE

(*Continued from page* 13)

The 160 gaging stations that are being maintained in the state furnish interesting and valuable evidence of the great diversity of runoff conditions which obtain within the state. The annual runoff varies from 3 inches or less on Long Island to over 50 inches on the western slopes of the Adirondacks. Since practically all of these gaging stations are equipped with water-stage recorders it is possible to make a variety of studies from the gage height graphs alone, such as studies of flood peaks and their rates of travel, correlations of rainfall and runoff, and, at the smaller stations, studies of the effect of transpiration and other losses.

The areas tributary to individual gaging stations in New York range from over 5,000 square miles to less than one-third of a square mile. Records of flow from very small areas are now in great demand in connection with hydrologic studies and for special purposes, such as the study now being carried on by the Geological Survey in cooperation with the State Department of Conservation to determine the effect of reforestation on runoff.

During recent years the Ground Water Division has maintained an office in Jamaica for the conduct of its investigational work on Long Island. Long Island is an area of rapidly increasing population and since its entire water supply must come from the island itself, careful management of ground water supplies is required to guard against the possibility and danger of salt water intrusion. The Jamaica office obtains records of ground water elevations from a large number of wells and receives records of pumpage. From these data the office is able to keep closely in touch with the variations in ground water level resulting from rainfall, evaporation, transpiration and other hydrologic factors and from pumpage for municipal water supply.

From the above it will be seen that the Geological Survey compiles a vast amount of basic data which is available to interested parties. Other Federal bureaus and agencies are similarly prepared to furnish valuable information along their own lines of activity. It has been the experience of the writer that engineers generally do not appreciate the value and extent of the basic data that are available to them. It is possible that a short college course, if it consisted only of one hour a week, which dealt with the sources of basic data, might be well worth while. Such a course would give the average engineering graduate a much better understanding of the basic information available to him and where it might be obtained.

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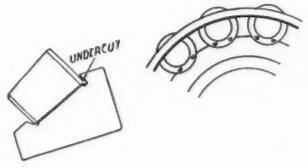

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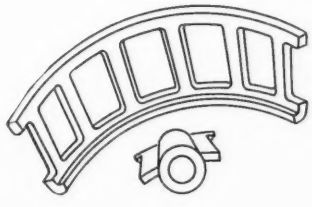

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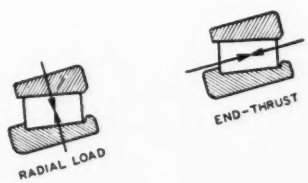

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Prominent Professors

PROFESSOR A. W. LAUBENGAYER

There are two important facts about Professor A. W. Laubengayer: (1) He is married to a Cornell Coed; (2) He is a chemist.

"Lauby," as he is called by his associates, was born on a farm in Kansas. From there the Laubengayer family began its migration to Schenectady, New York with a year stop-over in Virginia. Arriving in Ithaca in 1917, Lauby entered Cornell's B. Chem. course and proceeded to show Cornell that he was, above all, a good chemist. In those days, there were men waiters at Risley and one of them was B. Chem. student Laubengayer. When there was time off from mixing chemicals and carrying food to the coeds at Risley, he participated quite actively in the affairs of his fraternity, Alpha Chi Sigma. A survey of the house records shows the appearance of the Laubengayer name in a good many places. Of course, there was always time for a few dates with a certain Home Ec. student and these dates have turned into quite a habit. Mrs. Laubengayer was the coed mentioned above. As to Lauby's opinion of Cornell coeds—well, he's very enthusiastic and will tell anybody that Home Ec students make excellent cooks.

During 1918-1919 he worked with no less a chemical than ammonium picrate, and to those unacquainted with war-time tools, that particular chemical is noted for its ability to explode with no small amount of violence. This particular research was carried out in conjunction with the government ordnance program. Honors which came as a result of hard study were Tau Beta Pi and Sigma Xi. Graduation came in 1921, and upon locating an instructorship in Oregon State College, Lauby left Ithaca. But not for long; in 1923 he came back to Cornell to take more work in chemistry, this time for the degree of Ph. D. which he was awarded in 1926. From that time on he has been connected with Cornell's Department of Chemistry, going from instructor to head of inorganic chemistry. Frosh Chem E's know him for his excellent lecture course, Chem 110. Even though 110 is an eight o'clock, Baker 200 is always well-filled

(*Continued on page* 28)

PROFESSOR C. I. MILLARD

Vital to the engineer is the word *economy*—and in a practical sense economy of motion is vital in modern industry. To him who speaks of "motion economy" at Cornell there comes a name connected with the Industrial Engineering Department; the name of Professor C. I. Millard.

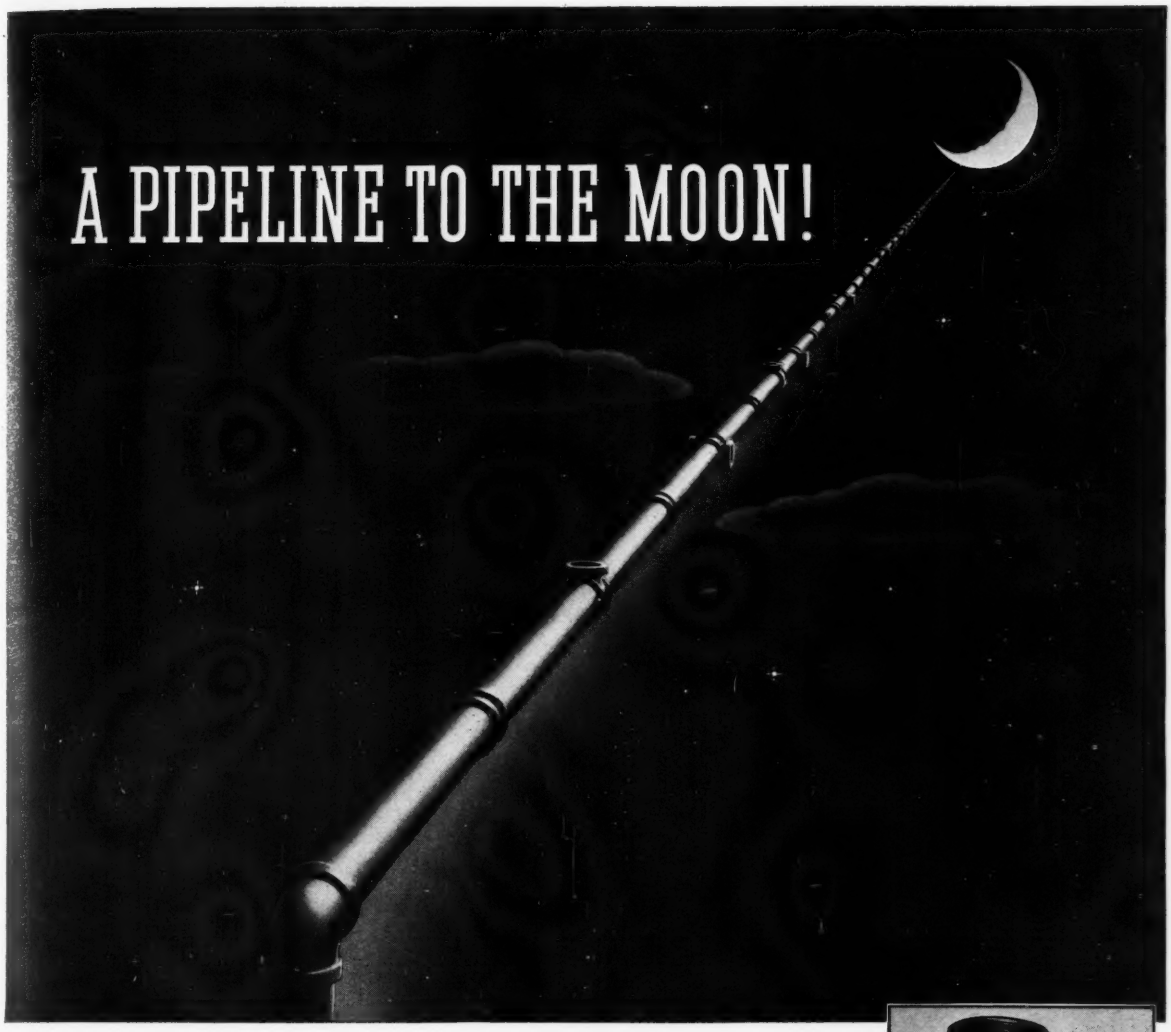
Clyde Millard has accomplished no little bit since his graduation from the Electrical Engineering School. He claims the distinction of having taught in all but two departments of the Engineering College since he returned here in the fall of 1927 to instruct in Machine Design. But probably most interesting of all his work is the phase in progress at present; the study of motion economy.

Familiar is his question, "How long does it take to toast three slices of bread with a toaster?" And next in line is this: "On which side of your vest should you carry your fountain pen?" To which the reply is invariably to the left of course. But here Clyde Millard the practical man demonstrates that for a right handed person the obvious side is the right, since six motions are required to prepare the pen for writing instead of nine. Not distantly connected with motion economy is the industrial course in studies of comparative costs and maintenance funds, in which he is very interested. Again the practical applications of the man are discernible, for even in this course the young engineer learns information useful in industry.

And then there is the Professor Millard not often seen . . . the one who works in his woodshop at home; who enjoys building things with his hands. With little professional help, he designed and built his own home, and says that he found constant applications for incorporation of comparative economy studies. Yet again, there is the man who likes to fish during his vacations—and takes time off to go to Florida for the big ones.

But always to the fore is the practical side of him. Always foremost is economy of movement, economy of industrial applications; yes, even a better way to catch more fish!

A PIPELINE TO THE MOON!



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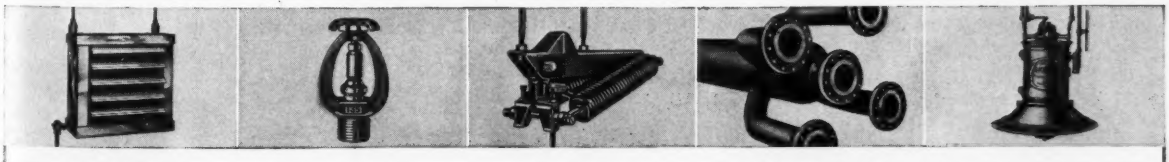

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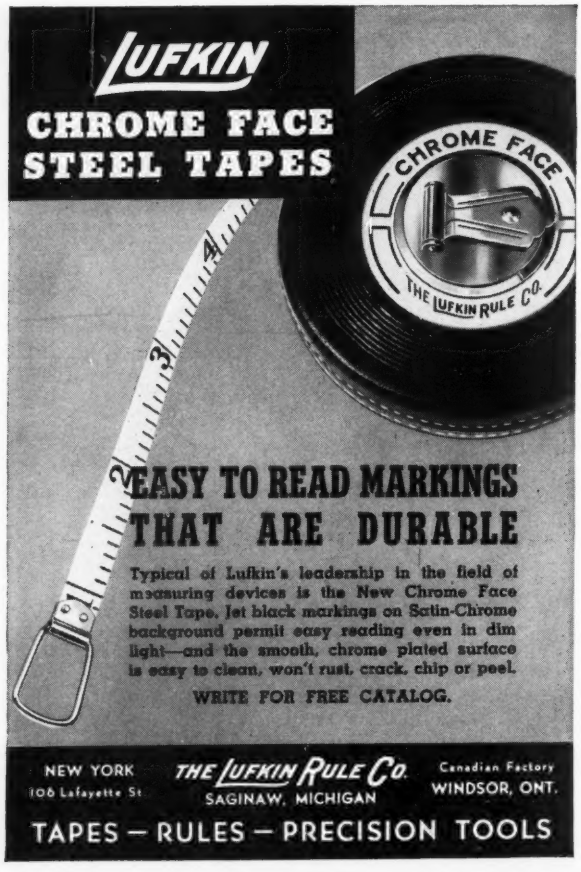
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THE INVENTOR'S CONTRIBUTION TO ENGINEERING PROGRESS

(*Continued from page* 7)

nificant that the vast development I have outlined has taken place during the period of one hundred and fifty years we are recognizing today. The resulting industrial and commercial growth during that period in this country is abundant proof of the value and importance of the work of our patent office.

EXPERIMENTAL DIELECTRICS

(*Continued from page* 10)

Variable Frequency Measurements

At the present time no variable frequency measuring equipment is in operation for our dielectric testing. Complete details have been worked out, however, for a low-voltage bridge which will have a frequency range from 100 cycles to one megacycle. This bridge will incorporate the most recent advances in bridge circuits so that the principles of guard balancing and completely guarded test cells will be used throughout the frequency range. Bridge balance will be affected by means of a cathode-ray oscilloscope instead of the usual indicating type instrument. This instrument permits a visual balance to be obtained in a minimum of time and with a maximum of accuracy.

PROF. A. W. LAUBENGAYER

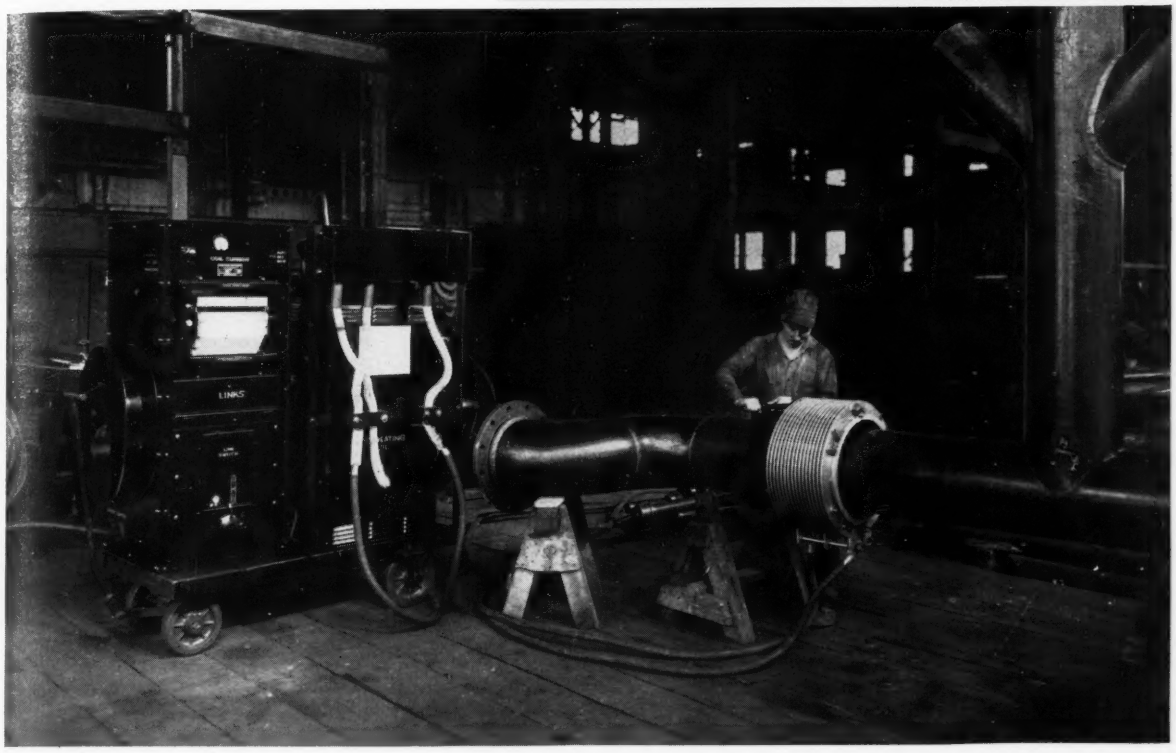
(*Continued from page* 26)

with its quota of note-taking Frosh, listening to a lecture which is presented in the clear-cut and informative style of Professor Laubengayer.

At home and during the vacation periods Lauby spends his time repairing and making household furniture, a hobby which Mrs. Laubengayer has found very practical. His stay in Oregon brought him into contact with stream fishing, a sport which he still enjoys.

Lauby enjoys his recreation but he also derives great pleasure from his work, and is the author of numerous research papers in inorganic chemistry.

High Pressure-High Temperature PIPING



Stress relieving a weld on a section of high pressure-high temperature piping. This is a standard procedure by Power Piping Division in the shop or in the field. Exact charts of each operation, preheating-maintaining preheat temperatures during welding operations and stress relieving, are automatically recorded and furnished the customer.

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COLLEGE NEWS

(*Continued from page* 17)

Barbara expounded "Engineering Uses of Glass." True McLean then went to bat for his AIEE and told us of Dr. Joseph A. Becker's lecture of April 12. Dr. Becker is connected with the Bell Telephone Laboratories and is a well-known authority on varistors and other forms of semi-conductors. He took this topic for his address. Cornell's AIEE was honored with the presence of the head of the AIEE, President F. M. Farmer, at the annual dinner of the Ithaca Section, Tuesday, April 30. Not to be outdone, George Mueden of the ASCE tells us of the visit to Cornell made by Col. John P. Hogan, President of ASCE. Hogan, who won his rank in the U. S. Engineer Corps during World War I, is a graduate of Harvard and has acted as consultant on such important projects as the Bonneville Dam, the Platte River Power and Irrigation project, and the Catskill Aqueduct for the City of New York. As chief engineer for the World's Fair, he directed $100,000,000 worth of construction.

This is about all that these men have to tell us and so we finish our cokes and take our leave. Right now it's just about time to hear the chimes strike eleven, and although the weather calls for cutting a class, I'm afraid that my marks in Machine Design will not stand provocation. So long and good luck on that prelim.

PRESIDENT'S MESSAGE

(*Continued from page* 18)

cational counselling . . . helping an alumnus determine what type of work he likes best and is best fitted to do, and also helping him plan his own campaign in finding a job. While this placement service is open to all departments of the University, the far greater portion of the work has been in behalf of engineering graduates. This year, as in the past, The Cornell Society of Engineers has contributed financially to this service. In addition, many members of this Society have given individual assistance.

Stimulation of Alumni Interest

It should be obvious that the purpose of this Society is not only a most worthy one but offers possibilities for great service within the organization to the College of Engineering and to the University. To accomplish any great purpose there must be interest and enthusiasm. Through the meeting of the Society, and more particularly through the meetings of the Regional Sections, such interest may be inspired and beneficial activities co-ordinated and directed. We now have only three such Regional Sections, in addition to New York. Several more should be created. A campaign to increase the number of Regional Sections, as well as to increase the membership of this Society, is now being organized. Its purpose is not to increase the membership as an end in itself but to increase the alumni usefulness to Cornell.

Very truly yours,
Willis H. Carrier
President.

STRESS and STRAIN

The victim of fallen arches is surely going down in defeat.

* * *

Smith: You say you flunked that course again? How come?

Jones: Well, what do you expect? They asked me the very same questions again.

—California Engineer

* * *

Gypsy: I tella your fortune mister.

Student: How much?

Gypsy: Twenty-five cents.

Student: Correct. Howdja guess it?

* * *

First Seagull: Who won the boat race down there, Yale or Cornell?

Second Seagull: Cornell just crossed the finish line first.

First Seagull: And to think that I put everything I had on Yale.

—The Wayne Engineer

* * *

"Hear about the fellow who invented a device for looking through a brick wall?"

"No, what does he call it?"

"A window, dope!"

—The California Engineer

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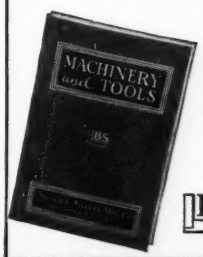

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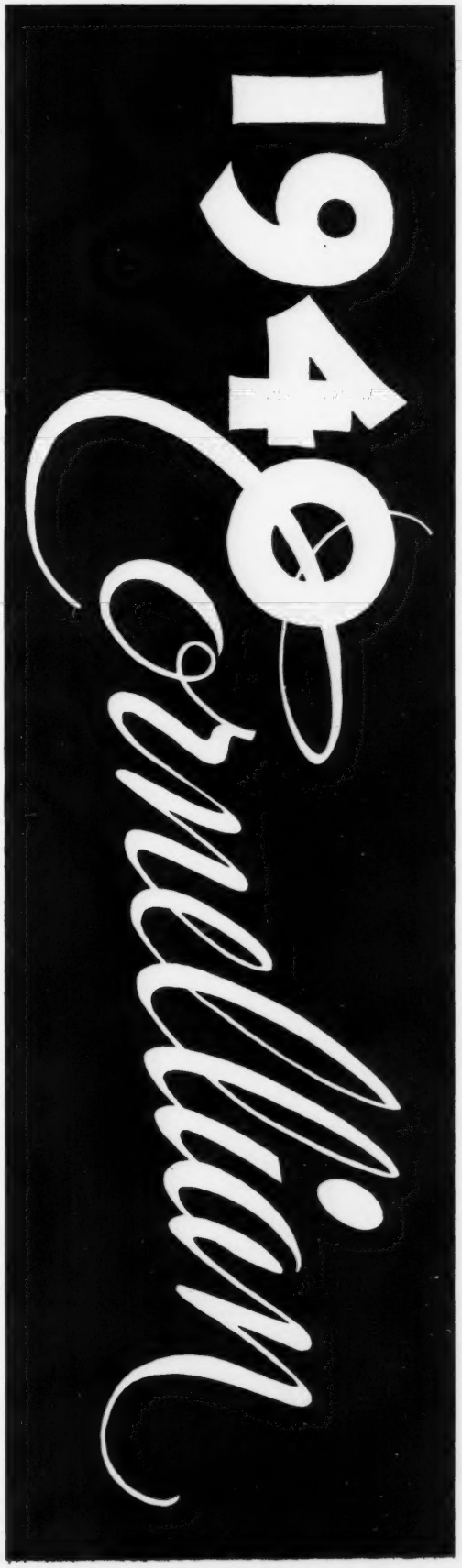

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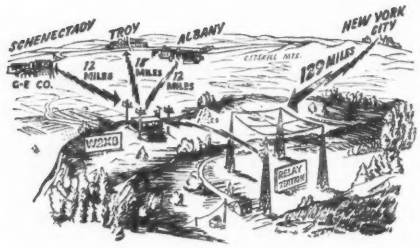


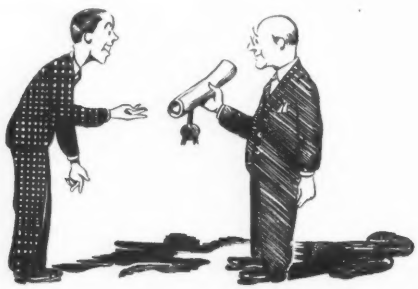
NETWORK TELEVISION

GENERAL ELECTRIC engineers passed another milestone on the road to large-scale telecasting when they recently demonstrated to the Federal Communications Commission the feasibility of network television.

Until a short time ago it was not thought possible to transmit television farther than the horizon. Recently, however, General Electric put into operation its new relay station, picking up programs originating in New York City 129 miles away, more than a mile below the line of sight. The New York programs are then retelecast over General Electric's Schenectady television station W2XB to homes in the Schenectady-Albany-Troy area.

FOR OUTSTANDING ACHIEVEMENT

GRADUATES from seven colleges, five of them also graduates of General Electric's famous Test course, were among the 22 G-E employees who were given Charles A. Coffin Foundation Awards this year for accomplishments which reflected outstanding initiative, perseverance, courage, and foresight.



James R. Alexander, Jr., U. N. C. '24, received recognition for perfecting equipment (developed by Arthur W. Burns, who also received a Coffin award for his work) using an "electric eye" to control temperatures in cement manufacture; Florian A. Arnold, Purdue '25, for designing automatic welding machines used in making fractional-horsepower motor stators; William S. Bachman, Cornell '32, for improving tone reproduction in broadcast receivers; James E. Beggs, Purdue '31, for developing a loop antenna for radio receivers; Eugene W. Boehne, Texas A & M '26, and Leonard J. Linde, South Dakota State '29, for developing a high-current circuit breaker which does not use oil as an insulating medium; Kenneth K. Bowman, Kansas State '26, M. A. Edwards, Kansas State '28, and Francis Mohler, V. P. I. '26, for developing Amplidyne controls for high-powered motors; Adolph F. Dickerson, Texas A & M '10, for lighting the Golden Gate International Exposition; and Simon H. Weaver, Purdue '03, for developing a heat stabilizing treatment for steam turbine shafts.

PHOTOGRAPHING LIGHTNING

PHOTOGRAPHING lightning is almost like trying to turn around and face yourself. By the time you've turned around, you're not there any more. But while nobody has yet been able to look himself in the eye, General Electric scientists have photographed lightning and recorded the wave shape of lightning strokes.

With a high-speed cathode-ray oscillograph and a high-speed camera installed in the tower of the Empire State Building in New York City, Dr. Karl B. McEachron, a former G-E Test man, directs the study of the characteristics of lightning. The lightning stroke itself "pulls the trigger" and puts the complicated mechanism into operation in one-millionth of a second.

Records obtained in this way help General Electric engineers to build electrical equipment that laughs at lightning — keeps the lights on and the factories running when thunderstorms come.

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